REMARKS

Claims 2 and 3 are canceled. Claims 1 and 4-11 remain pending. Claim 11 was withdrawn from consideration. The specification and claims were amended to correct a typographical error ("principle plane" was corrected to --principal plane--). The rejections set forth in the Office Action are respectfully traversed below.

The Prior Art Rejections

Claims 1 and 8 were rejected under 35 U.S.C. §102 over **Almogy et al.** (USP 5,661,590). Claims 1 and 8 – 10 were rejected under 35 U.S.C. §102 over **JP 11-135823**. Claims 7 was rejected under 35 U.S.C. §103 over **Spaeth et al.** (USP 5,218,223) in view of either one of **Almogy** or **JP '823**. Claims 1, 4, 6, 8 and 9 were rejected under 35 U.S.C. §102 over **Ng** "Complete Guide to Semiconductor Devices" or, in the alternative, under 35 U.S.C. §103 over **Ng** in combination with either one of **Almogy** or **JP '823**. Claim 3 was rejected under 35 U.S.C. §103 over **JP '823**. Claim 5 was rejected under 35 U.S.C. §103 over **JP '823**, in view of **Makiuchi** (USP 5,932,114). It is submitted that nothing in the prior art, either alone or in combination, teaches or suggests all the features recited in the present claimed invention, as amended.

For instance, independent claim 1 was amended to incorporate the subject matter of claim 3, the combination of which is not taught or suggested by the cited prior art. Claim 1 recites the characteristics of a flat side face being a cleavage face inclined to a line perpendicular to a principal plane of the semiconductor substrate, as well as being substantially perpendicular to an incoming

photo signal, and another side face parallel to said flat side face. The cleaved flat side faces of the semiconductor substrate are parallel to each other, without being lapped or polished. Moreover, claim 6 recites the principal plane of the semiconductor substrate being inclined to a (100) plane. These features are further explained below.

A cylinder-shaped monocrystalline ingot is conventionally cut into wafers (substrates) so that the principal planes (the top face of the substrate) of the substrates become parallel to a [100] plane. In many cases, the ingot is cut into substrates by dicing, instead of cleaving, and each substrate is "lapped" or "polished", and are further "chemically polished" so as to make the principal plane of the substrate smooth like a mirror. The photo absorption layer and other layers are formed on the principal plane of the substrate thereby to form multiple photo detecting devices on the substrate. In such a conventional case, the principal plane (top face) of the substrate is parallel to the [100] plane, and the substrate is not inclined to the [100] plane. The side faces of the photo detecting device may be formed by cleaving in the [100] plane, for example, that is perpendicular to the [100] plane.

The photo detecting device according to the present invention, however, is different from such a conventional photo detecting device in that the principal plane (top face) of the substrate ***is inclined*** to the [100] plane by 20°, for example, which means that, the substrate is cut from a cylinder-shaped monocrystalline ingot so that the principal plane (the top face of the substrate) of the substrate forms an angle of 20° to the [100] plane. The side face of the photo detecting device according to the present invention is formed by cleaving in the [100] plane, for example. In this

case, the cleaved side face (the [100] plane) forms an angle of 20° to the principal plane of the substrate because the [100] plane is already slanted (inclined) to the principal plane of the substrate, and the [100] plane is perpendicular to the [100] plane. The cleaved side faces do not need to be "polished" or "lapped" in order to adjust the angle that the side face forms to the principal plane of the substrate. The cleaved side face does not need to be polished or lapped because it is optically flat.

As recited in amended claim 1, the cleaved side face on the other side of the photo detecting device is parallel to the cleaved side face that adapts the incoming photo signal because both are formed by cleaving in the [100] plane. The prior art do not teach or suggest these features.

Almogy

Fig. 3 of **Almogy** does not show a facet at the left side. However, keeping in mind the fact that the polished 45° facet shown in Fig. 56.1(a) of **Ng** is not a cleaved facet (explained below), those skilled in the art would recognize that there is another 90° (for example) cleaved facet at the left side of the photo detector shown in Fig. 3 of **Almogy**, and the right-side 90° "cleaved facet is later lapped to a 45° angle." Accordingly, the Applicants believe that one skilled in the art would not interpret **Almogy** in the manner described in the Office Action.

Ng

Referring to Fig. 56.1(a) of **Ng**, notice that the right facet is perpendicular to the top face of a GaAs substrate. Similar side facets perpendicular to the top face of a GaAs substrate are also shown in Fig. 56.1(b). These facets must be cleavage facts. On the other hand, it is clear that the "polished 45° facet" is a 90° (cleavage) facet polished to 45° .

Those skilled in the art would recognize that photo detectors formed on a compound semiconductor substrate (a GaAs and an InP substrate, for example) are usually separated by cleaving the substrate. However, the angle that a cleavage facet forms to the top face of the substrate is fixed (constant). It is impossible to form a 90° facet at one side of a photo detector and a 45° facet at another side of the photo detector. Since the cleaving is "triggered" by a shock given to a portion of the substrate, the angle that a cleavage facet forms to the top face of the substrate is not selectable between 45° and 90°, for example. This is the reason why, in the case of **Ng**, one of the 90° cleavage facets formed at both sides needs to be polished to 45°.

JP '823

Dicing is a process in which a substrate is cut with a blade (containing diamond particles, for example) rotating at a high rotative speed. The blade mechanically removes the portion of the substrate that the blade touches. One can form a side facet making any desired angle by controlling the angle of the blade to the substrate. However, the side facet formed by dicing needs to be polished to make it an optically flat facet.

On the other hand, cleavage is a process in which a monocrystalline substrate is divided along an intrinsic crystalline place (cleavage face) such as [110] plane and [111] plane of the monocrystalline substrate by giving of a shock onto the surface of the monocrystalline substrate. The "cutter" (page 11, line 14) is a wedge-shaped object, for example, with which the force is applied to the monocrystalline substrate. If the shock is given in an appropriate direction, the substrate breaks at the cleavage face into two parts. Since the cleavage face is physically intrinsic flat face of a monocrystalline substrate, it is optically flat. This is an apparent structural difference between the conventional use of etching and dicing versus the present claimed cleaving.

Makiuchi

If the [100] plane is used as the principal plane of the substrate, either the [110] plane (cleavage face) or the [111] plane (cleavage face) is obtained by cleavage. In order to obtain the [111] plane (cleavage face), the direction in which the shock is given to the substrate needs to be carefully selected.

However, since the side face is preferred to be perpendicular to the incoming light signal, the angle that the side face makes to the principal plane of the substrate is controlled by inclining (slanting) the principal plane of the substrate form the [100] plane as claimed in claim 4 (page 9, lines 15-19).

If the angle that the side face makes to the principal plane of the substrate exceeds 30 degree, the edge becomes sharp and physically weak (page 10, lines 27-32). Accordingly, the flat

side face is preferred to the inclined to the line perpendicular to the principal plane at an angle of 30° or less as claimed in claim 5. This limitation is required for preventing sharp edge of the substrate from being damaged when the substrate is cleaved. This is a feature that is not disclosed in **Makiuchi**.

For at least the reasons set forth above in detail, the present claimed invention, as amended, patentably distinguishes over the prior art. Entry of this amendment is respectfully requested to place the present application into condition for allowance. If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact the Applicant's undersigned attorney at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

In the event that this paper is not timely filed, Applicant respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees that may be due with respect to this paper may be charged to Deposit Account No. 50-2866.

Respectfully submitted,

WESTERMAN, HATTORI, DANIELS & ADRIAN, LLP

John P. Kong
Attorney for Applicant(s)
Reg. No. 40,054

JPK/jli
1250 Connecticut Avenue, N.W. Suite 700
Washington, D. C. 20036
202-822-1100 (t)
202-822-1111 (f)